

Electronic Shelf Labeling System

ESL

OPTICON



User Manual

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1. Features and Specifications

1.1 Abstract

This manual describes how to set-up the e-Paper Electronic Shelf Labels (ESL) System and includes pre-loaded software for demonstration and pilot project purposes.

Contents

The ESL demo kit consists of the following components:

- Ethernet ESL base station (EBS-10)
- Six 2-inch e-paper ESLs (EE200) including 6x2 CR2450 batteries
- UTP cable
- 6.0V 2A Power supply
- PC Installation Software + examples
- Manual
- (Optional barcode terminal)

1.2 Physical Features

1.2.1 Dimensions and Weight

<i>Item</i>	<i>Dimensions</i>	<i>Weight</i>
Standard shelf tag:	(w x h x d): 70 x 33 x 14mm; 2.76 x 1.30 x .55in	2.5g (.09oz)
Base station:	(w x h x d): 129 x 28 x 102 mm; 5 x 1 x 4in	125g (4.4oz), excluding antenna

1.3 Environmental Specifications

1.3.1 Operating Temperature and Humidity (EE200)

Temperature: 0 to 50° C

Humidity: 0-85%

1.3.2 Storage Temperature and Humidity (EE200)

Temperature: -20 to 60° C

Humidity: 0-85%

1.4 Interface Specifications

The radio interface of both the base stations and ESLs have the following specifications:

- 2.4GHz IEEE 802.15.4 compatible
- Transmission speeds: up to 250 kbps

1.5 Hardware Specifications

Items	Specifications		Remarks
CPU	Type	CC2530-F128 (EE200) CC2530-F256 (EBS-10)	
	Internal ROM	256 KB (EBS-10) 128 KB (EE200)	
	Internal RAM	8 KB	
	Clock frequency	32 MHz	
Display (EE200)	Active area	W 45 x H 22 mm	
	Number of dots	W 200 x H 96	
	Model	EG020AS183	
	Gray scale level	1 bit	Black and white
	Contrast ratio	10:1	
	Pixel pitch	111 dpi	
Connector (EBS-10)	Ethernet	10/100 Mbit	
Radio	Frequency	2.4GHz	
	Protocol	IEEE 802.15.4	

1.6 Electrical Specifications

1.6.1 Electrical Characteristics

EE200:

Parameter	Typical	Unit	Remarks
Operating voltage	2.8–3.2	V	2 x CR2450 Lithium battery
Operating current	7-33	mA	During RF and image refresh only
Sleep current	1	uA	EE200 in sleep state >99,9%

EBS-10:

Parameter	Typical	Unit	Remarks
Operating voltage	6.0	V	Power adapter
Operating current	<200	mA	

1.6.2 Main Battery:

- The main batteries in the EE200 are 2 CR2450 Li-Mn batteries:
- Nominal capacity: 2x600 mAh
- Nominal voltage: 3V.
- Low voltage: Less than 2.8 V
- Operating time: >7 years (default settings; 4 refreshes/day; 15-25° C)

The operating time of the batteries is based on a realistic estimation of any of the following factors that influence the battery life:

Factor	Default s values and estimated averages	Correlation * (higher is better)	Influence
Polling for data & reporting settings	Interval: 20 seconds Retransmissions: 10% Report ratio: 1 to 39	Yes No Yes	61%
Display updates	4 per day Temperature: 15-25° C	No No	20%
Out of range / base station OFF %	Not connected: 2% Number of channels: 5	No No	4%
Sleep time	99,9%	Yes	9%
Battery self-discharge	1 % / year	No	6%

* The correlation shows whether increasing the listed value increases or decreases the power consumption.

For example:

- Increasing the poll interval lowers the power consumption
- Turning off the base stations increases the power consumption
- A lower operating temperature increases the power consumption
- More display updates per day increases the power consumption

1.7 Serial Number

EBS-10

The serial number can be found on the back of the Base station. The EBS-10 is currently only available as Engineering Sample, which can be recognized by the serial number starting with "ES."

EE200

The serial number of the ESLs is based on the 16 hexadecimal digits MAC-address of the RF-module. However, the first 6 digits of the MAC address (00124B) have been replaced by the letter "A."

The default barcode that is shown on the display of the ESL is identical to the bar code on the back of the ESL.

1.8 Safety

Handle this product carefully. Do not deliberately subject it to any of the following.

Shock

Do not throw or drop the devices.

Temperature Conditions

Do not use the devices at temperatures outside the specified range.

Do not pour boiling water on the devices.

Do not throw the devices into the fire.

Do not forcibly bend the cable at low temperatures.

Foreign Materials

Do not immerse the devices in liquids.

Do not subject the devices to chemicals.

Other

Do not plug/unplug the connectors before disconnecting the power.

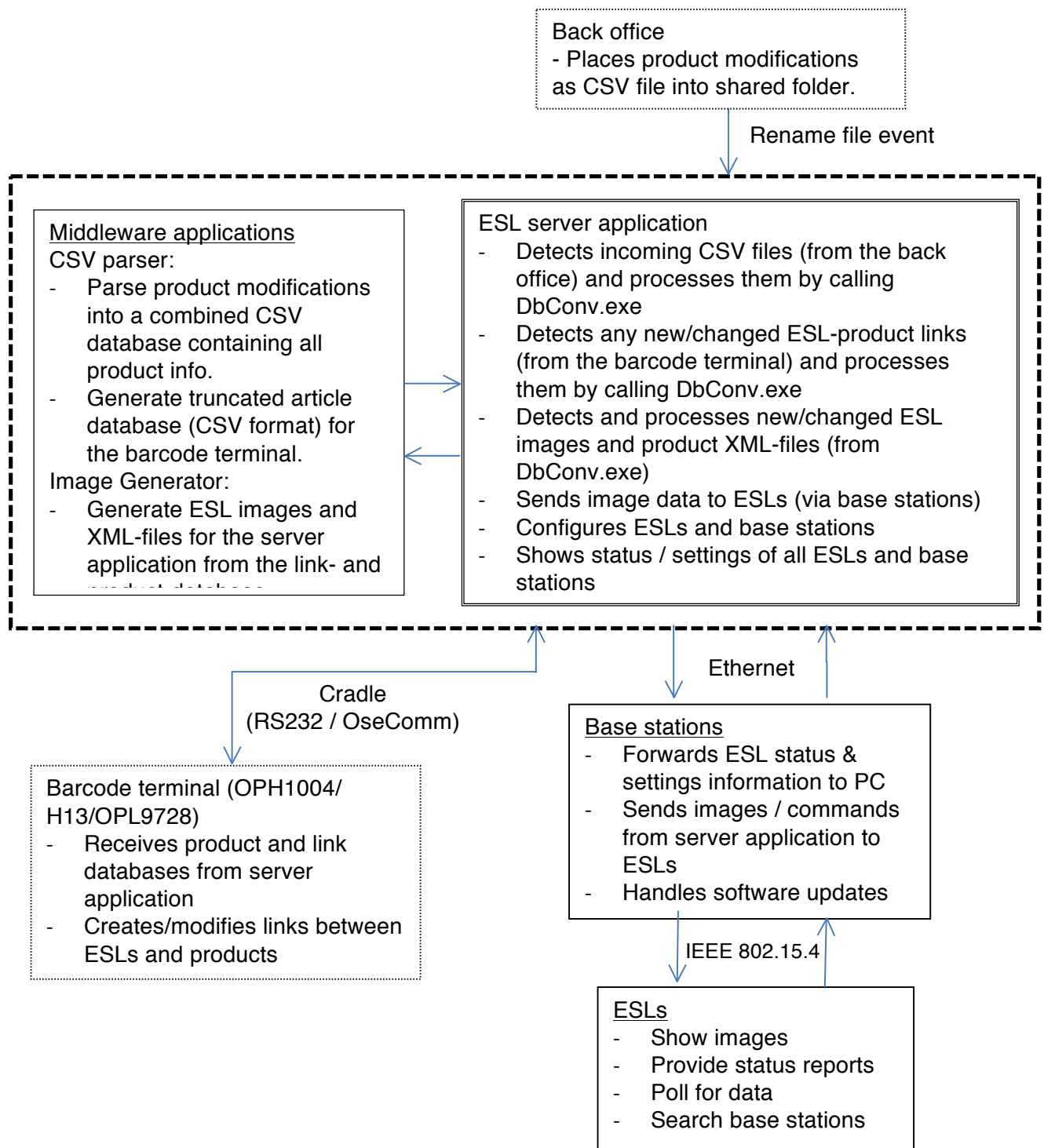
Do not disassemble this product.

The device may be damaged by power surges

2. Solution Overview

The current solution operates by running the provided ESL server application that monitors an incoming folder in which any mutations in the product database are being placed by the back office system of the user. Any detected changes will be automatically processed and sent to the ESLs and displayed.

A global overview of the current solution is shown below. The following chapters will describe the different parts of this system in more detail and how to get started.



3. Getting started

3.1 Setting up the Hardware and Software

This kit contains the following pieces of hardware and software that will have to be installed in order to get an ESL demonstration or pilot up and running:

- ESL kit installer includes:
- The ESL server application
- Middleware applications
- Example database files and image templates
- Firmware for the barcode terminal, base station and ESLs
- Appload (optional)
- USB drivers for the barcode terminal cradle (optional)
- XTAdminXXL (optional)
- User manual
- 1 EBS10 Base station
- 6V Power supply
- Ethernet cable
- Six EE200 2-inch e-paper ESLs (batteries included)

Note: If you want to be able to quickly link ESLs to products, you will also need an OPH1004, H13 or OPL9728 barcode terminal kit that includes:

- A communication cradle
- An RS232 and/or USB cable.
- A 6V Power supply

To install and run the software you will also need a PC running Windows 7 or Windows XP (with server pack 3) as server.

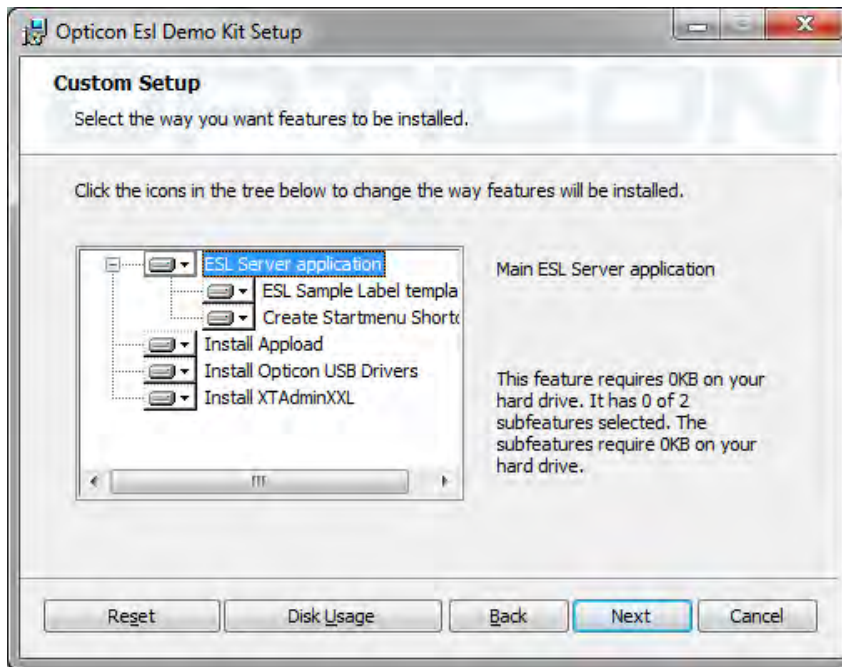
3.1.1 Installing Elements of the ESL Kit Software

Make sure you have administrative rights before installing the software. Run the SDK installer by starting the *setup.exe* file.

If your PC doesn't have .NET Framework 3.5 (or higher) installed, the installer will automatically install it on your system, since the ESL Server application requires it to run.

Select the components that you wish to install. If you haven't installed *Appload* or the Opticon USB drivers on your PC before, make sure you install those components as well.

The *XTAdminXXL* tool is a 3rd party tool from AK-NORD that allows you to discover your base stations on an Ethernet network and configure the Ethernet settings of base stations. (See section 5.6).



Note that only the installer for *XTAdminXXL* will be copied to the 'Tools'-folder of your installation. To actually install the program, this installer needs to be run manually.

3.1.2 Installing the base station

The base station can be easily installed by: powering it up; connecting it to the Ethernet; and placing it within 10 meters (approximately 33 feet) of your ESLs. (Note that the actual maximum coverage range is much wider). The PC will need to be connected to the same LAN, so it can communicate with the base station*. See section 5.6.3 for more information on configuring the Ethernet settings of your base station. Other information on how to configure the base stations (i.e. selecting the best RF channel) can be found in section 5.6.1.

** Note: The base station can also be controlled over the Internet, or via a public network, but it this is not a secure solution, since SSL isn't supported yet in this SDK.*

3.1.3 Installing the ESLs

On arrival the ESLs usually already have their two CR2450 batteries inserted. If not, the batteries can be easily inserted by removing the back shell. When the batteries are inserted, the ESLs will be periodically seeking for an Opticon base station, so as soon as an Opticon base station is within range, they will associate with it and start sending data requests and status information to it. When a base station is turned off, or an ESL is moved out of range, an ESL will time out after a couple of minutes and start seeking for another base station in range.

Since there are many types of mechanisms to mount shelf labels to shelves, the ESLs of the

demo kit are supplied without mounting clips. Please contact Opticon for more information on the mounting possibilities of the ESLs to your shelves. For simple demonstration purposes with small amounts of ESLs one might also consider using double sided foam tape as a temporarily solution.

3.1.4 Installing the Optional Barcode Terminal

The optional barcode terminal can be used to link an ESL (using its unique MAC addresses) to any type of product, objects or location as long as it has a unique identifier it can be linked with. Example of unique identifiers include: an EAN-barcode; a serial number; a specific position or location; a room number, etc.

More information on how to set up the barcode terminal can be found in section 5.7.11.

3.2 Linking a Back Office System to the ESL Server

The ESL server application is triggered by CSV files that are being placed in the specified *Input Folder* by the back office. Using a shared folder it's possible to allow external access by the back office from anywhere in the world.

If the back office link to the ESL system is not yet available, then it's also possible to manually place (and rename) some CSV files in the *Input folder* for demonstration purposes and testing. (See section 5.1).

See chapter 2 for information about on setting up the back office system.

3.3 Resetting the ESL System

After installing and configuring all the components listed in this chapter, it will be necessary to reset the complete ESL system, since on start-up the ESL server will already have parsed the example database file, which will have to be replaced with your own CSV export.

Note: if the field sequence of your CSV export is ever changed, it will be necessary to reset the ESL system by deleting the existing product database. However, do NOT delete the link database (step 3) because otherwise you will have to manually link all ESLs again using the optional barcode terminal. The existing database files can also be replaced remotely by the back office, by placing a complete database CSV file in the 'Input folder' that contains only empty modification fields. (See section 4.1).

To reset the ESL system manually, the following steps have to be taken:

1. If still present, delete the sample database file from the *Input folder* of your installation (*ProductData_1.csv*). If the sample database file has already been moved to the *Processed* folder, then it's not mandatory to delete it.

2. Go to the Setup-window of the ESL server application and press the *Delete database* button to delete the generated database files: *dbase.csv* and *scan.csv*.
3. (Optional) If you've manually linked any ESLs using the sample database or want to redo the linking of all ESLs, then press the *Delete links* button to delete the link file (*linked.csv*). Before closing the Setup window, delete any existing links from the barcode terminal as well by using *4 settings > 1 Delete Data* to prevent any links from being resent by the terminal.

After deleting the necessary files and closing the *Setup* window, the system will automatically start detecting any incoming CSV files in the configured *Input folder* again. (See chapter 4).

3.3 Designing the ESL image layout

Probably the most important step in the customization process of the ESL system is determining the design and format of the images that should be displayed on the ESLs.

When designing the layout of an e-paper ESL it's important to know the limitations of what can and what can't be displayed.

The main characteristics are:

- Fixed resolution of 200x96 pixels
- Monochrome images only (black/white)
- No anti-aliasing can be used on fonts (limiting the amount of available fonts)
- Monochrome company logos and other product (group) images can be added to the layout.
- Barcodes can be added using data of CSV database
- Texts can be rotated only in 90° angles (currently only horizontal is supported in this version)
- Dynamic texts, using information from the database, can be added and aligned as desired.
- Different templates for groups of ESLs is possible by adding objects to the template using logical conditions (i.e. condition: 'field x' (group) equals '5')

Currently, the layout of an ESL image is specified using a template file, which is XML-based. Using very basic XML tags, it is possible to manually edit the included example template. Default location of the template is *./Templates/Image.xml*.

Detailed instructions on how to edit the XML-based image template file can be found in *Appendix A*.

4. Back Office

The back office triggers the ESL server application by placing a file containing either only product modifications or a complete product database in a predefined folder. Only one file may reside in this folder to enforce sequential handling. This means that the Back office may only store another file, when the current file has been processed and moved to a different folder.

To avoid read/write conflicts the database files should first be copied into the specified folder under a temporary name (i.e., *.tmp) and renamed to the correct name afterwards. The ESL server application will only trigger on “rename file” events. If any database file is placed in the folder while the server application isn’t running, the file will be processed as soon as the server application is started again.

4.1 Database format

Currently the only supported database format is CSV (comma separated values) with the following properties:

- Allowed field separator(s): **1) semi-colons**
- Methods: 1) modification database (add, replace, delete) and 2) complete database
- Each product in the database must contain a unique product ID field to allow linking of an ESL to a product
- If there’s a 1-to-many relation between the unique product ID and the barcode on this product, then the same product should be added to the database multiple times for each unique barcode, but all other fields must be identical. Also any product modifications (like price) should be applied on each record for this product
- The adding of a product barcode field to the database isn’t mandatory. However it is recommended, since it adds the possibility to quickly link ESLs to a product by simply scanning the barcodes on the product and the ESL using the barcode terminal.
- If any, comment lines should start with ‘#’

When using a **modification database**, the modification field should be located at the beginning of each line. **As modification code, the characters ‘I’ (Insert), ‘R’ (,) and ‘D’ (delete) should be used.**

The typical record format of a product modification database would be:

```
<Modification code>;<Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.
```

When a **complete database** is used (meaning any new database file replaces the previous one), the **first (modification) field of each line must be left empty.**

The typical record format of a complete product database would be:

```
; <Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.
```

It is recommended to add any fields that should be displayed on the ESL in the same formatting as they should be displayed on the ESL. This way the middleware application that generates the images, won't have to be modified and only the image template has to be customized.

The ESL server application never directly uses the provided CSV files, because the middleware software actually processes these files. For this reason, only the middleware applications have to be customized or configured and not the ESL server application itself.

Note 1: Due to the 1-to-1 relation between a product and an ESL, it is currently not possible to link multiple ESLs to the same product.

Note 2: Database formats other than CSV can be supported, but require modifications to the existing middleware application, so this is not recommended when time is critical.

5. ESL Server Application

The ESL server application controls the whole ESL system by detecting all external triggers and processing the given data. Its main tasks are:

- Detecting incoming CSV files from the back office
- Detecting new/changed ESL-product links from barcode terminal
- Processing new/changed ESL images and configuration files from the middleware application
- Calling of the middleware application to process all input files to create the images and configuration files needed to update the ESLs.
- Configuring of ESLs and base stations
- Sending image data to the ESLs (via the base stations)
- Showing the current status and settings of all ESLs and base stations
- Logging all events, errors and executed tasks
- Handling of software updates for base stations and ESLs

In the following sections, these ESL server application tasks will be described.

5.1 Handling of incoming CSV files from the Back Office

The placing and processing of incoming CSV files is done as follows:

- The file is moved/copied to a configurable local folder, called the *Input folder*.
- When moving/copying the file from the Back office to the folder a temporary name is used, i.e. *productdata_1.tmp*, *productdata_2.tmp*, etc.
- After a check that the complete file has been moved/copied, the file will be renamed to its final name, i.e. *productdata_1.csv*, *productdata_2.csv*, etc.
- The server application will pick up the CSV file as soon as it detects this rename file event.
- The numbers in the filenames should be sequential, and the interval is 1. The ESL server application currently does not check the number of these files.
- The file will be processed instantly, as the records contain no start/end date.
- Once a file is processed, it will be moved to the configurable *Processed* folder and the back office is able to put another file in the folder.
- When errors occur, they will be reported in an error log in the *Log* folder. The data file will not be moved in case of errors.
- The ESL server application will call the middleware applications to parse the incoming CSV file into a combined database file and generates the required configuration and image files that are used to update the ESLs.

5.2 Handling of modified ESL-product links (*linked.csv*)

Linking the unique MAC address of the ESL label to the unique product ID establishes the link between an ESL label and a product.

To create, modify or delete a link, a barcode terminal can be used (see chapter 7). Once the links have been made, they will automatically be transferred back to the PC as soon as the terminal is placed back into its cradle.

To process the modified links, the middleware applications will automatically be called by the server application as soon as the link-database is received.

If no barcode terminal is being used and the ESL are linked using a different method (i.e. using the existing cash register), then the *linked.csv* file should be placed in the *Output* folder as follows:

- When moving/copying the link-file a temporary name should be used, i.e., *linked.tmp*
- After that, the file should be renamed to its final name, *linked.csv*, which will overwrite any existing file of the same name

Each record of the link-file should have the following exact format:

```
<Unique ID>;H;<16-digit MAC address>
```

For example: *

```
10244;H;00124B00011B344D  
12345;H;00124B00011B432F  
197;H;00124B00011B432F
```

The ESL server application will automatically pick up the new link file as soon as it detects this rename file event.

** Note: The character 'H' is added to specify the hardware variant of the ESL. Currently only the 2" e-paper ('H') and 2.7" e-paper ('K') are supported.*

5.3 Detecting New/changed ESL image and Configuration Files

After the server application has detected a new product data file from the back office, it will call the middleware applications to parse the incoming CSV file into a combined database file and generate the required configuration and image files that are used to update the ESLs.

Both the configuration and image files will be placed into the configurable *Output* folder. The files will be placed in the sub-folder: *Images*. (Once processed the images and XML-files will be moved to the subdirectory: *Images/Completed*).

The server application will automatically process the BMP- and XML-files that have been placed in the *Images in* folder. Once it has successfully processed a file, by sending the image to an ESL, it moves the files to the sub-directory */Completed* of the *Images in* folder.

The middleware application will only generate new configuration and images files for products that are not found in the *Completed* subfolder or have been changed.

The ESL server application processes any changed files and checks the images folder for unprocessed files:

- On startup
- After receiving a new link-database from the terminal
- After a rename event of:
 - Any new product CSV file in the *Input folder*
 - The ESL-product link file (*linked.csv*) in the *Output folder*
 - The Image layout file (default: *image.xml*)
 - The XML-template file (default: *info.xml*)

If any manual changes to the image folder have been made (like deleting image files from the *Completed* folder), these changes aren't automatically detected. To force an update, select the *Data* tab in the server application and press the *F5* key.

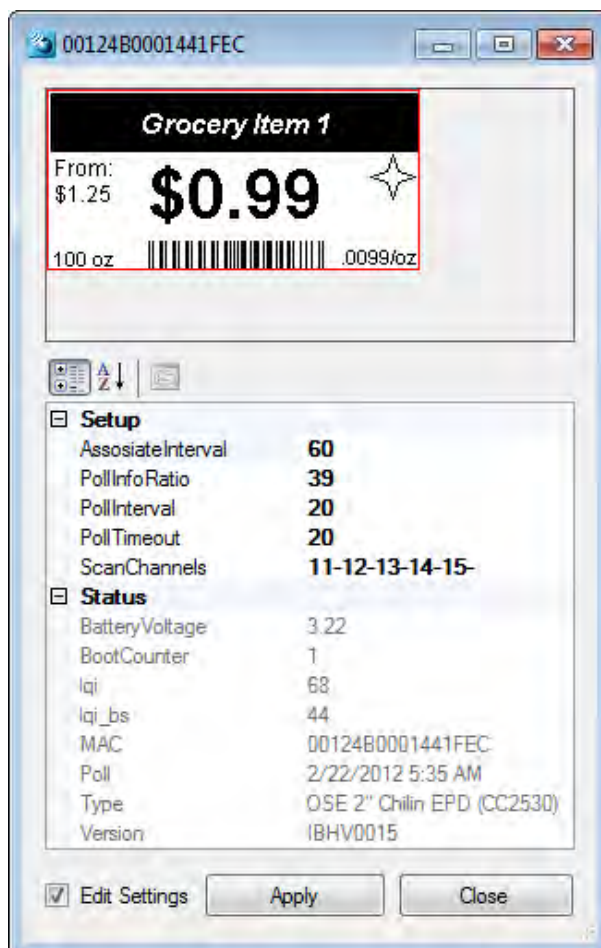
5.4 Configuring ESLs

Besides sending images to the ESL, there are a number of configurations that can be made in the ESLs to control, customize and to regulate power consumption.

To edit configurations of an ESL, go to the base station tab to which the ESL is currently linked and right click on the ESL. After doing so, a settings dialog should appear, showing the current status and settings of that ESL. (If the base station has not yet received the settings from this ESL, then it will automatically request the settings the next time the ESL sends a poll for data.)

To edit configurations, check “Edit Settings” in the left bottom corner. After that, there will be five configurations that can be edited. In following sections, these configurations will be described:

- Associate Interval
- Poll info ratio
- Poll interval
- Poll timeout
- Scan channels



To edit multiple ESLs at the same time, press the shift- or ctrl-key in the base station tab to select and configure multiple ESLs at the same.

5.4.1 Associate interval

When an ESL is not connected to any base station it will automatically start looking for nearby base stations. Since searching for base station consumes a relative large amount of power it will not continuously search, but only once every couple of seconds. The associate interval determines the time (in seconds) between two associating attempts of an ESL. The default associate interval is currently 15 seconds.

Please note that ESLs consume much more power while not being connected to a base station than when they're connected, so it's strongly recommended to never turn off the base stations once a network of ESL's is operating. If ESLs are not being used for a long period of time the associate interval can best be set to a much longer interval like 300 seconds. For an even longer period of time, removing the batteries might be the best option.

The amount of power that is being consumed by the ESL, when it's not connected to any base station is also strongly related to the number of RF channels it is configured for. More information about the configuration of the 'Scan Channels' can be found in section 5.4.5, below.

5.4.2 Poll Info Ratio

The poll info ratio determines how often ESLs will automatically send their current status and settings to the base stations. By default the ESLs will transmit this information once every 40 polls, so a ratio of 1:39.

The status and information of an ESL is also requested immediately by opening the settings dialog of an ESL by right clicking on the ESL. This will cause the base station to request the settings the next time this ESL polls for data.

The poll info ratio is set to a relative high value, because settings and status usually don't vary a lot and because sending settings and status information uses more bandwidth and consumes more power than regular polls for data.

5.4.3 Poll Interval

The poll interval specifies the interval (in seconds) for the ESL to poll the base station for data. This parameter is the most significant configuration of an ESL since it strongly determines the response time of an ESL (how fast is an image displayed) as well as battery life.

By default the ESLs poll every 15 seconds once they're connected to a base station. This means that the response time of an ESL can be anywhere in between 0 to 15 seconds (unless the poll doesn't arrive at the base station due to interference).

The poll interval greatly influences battery life, so lowering it is not recommended. For example, changing the poll interval from 15 seconds to 5 seconds will roughly double the power consumption and thereby shorten the battery life by a factor of 2.

An advantage of making the poll interval bigger is the reduction of the used bandwidth per ESL,

making it possible to connect more ESLs to a single base station.

5.4.4 Poll timeout

The poll timeout specifies the number of polls without acknowledge from the base station after which the ESL will time out its connection and start searching for another base station. The default poll time out is currently 30 polls, so by default the time out is 450 seconds (30 polls x 15 seconds).

5.4.5 Scan channels

Once an ESL has associated (connected) to a base station, it operates on a single RF channel. However when it's not yet connected to a base station, the ESL will automatically scan a range of RF-channels for base stations. The range of RF channels that an ESL will scan for base station is configurable. All channels between 11 and 26 can be scanned by adding the channel in the dash-separated list of channels.

By default, the channels 11 to 15 (i.e., 11, 12, 13, 14, and 15) are enabled. Channel 11 can't be disabled. This is to ensure that when an ESL that is not associating to any base station, and the ESL's RF channel range is unknown, it can always be retrieved by configuring a nearby base station to channel 11.

5.5 ESL status information

Each ESL will also periodically transmit the following status information.

- Battery voltage: Current battery voltage
- Boot counter: Number of times the ESL has been reset (automatically and manually)
- LQI: Indicator of the signal strength from an ESL (from ESL to base station)
- LQI BS: Indicator of the signal strength from an ESL (from base station to ESL)
- MAC: 16-digit MAC address of the ESL
- Poll: Time of the latest poll that has been received from the ESL
- Type: Hardware variant of the ESL
- Version: Software version of the ESL

5.6 Configuring of base stations

Base stations have very few configurations besides the configuration of the Ethernet module (which will be described in section 5.6.3). The only main configuration is the RF channel on which the base station operates.

5.6.1 Configuring the RF Channel

The base station always operates on a single RF channel, which can be selected in a range of channel 11 to 26 (as specified by the IEEE 802.15.4 standard). When using multiple base stations it's also strongly recommended to use a different RF channel for each base station within range to improve the maximum throughput of data and reduce data collisions.

Since the IEEE 802.15.4 base station and ESLs operate on the same frequencies as WIFI and Bluetooth, it's important to make sure that a base station does not operate on the same RF channel as any nearby WIFI network to minimize interference.

To detect which RF-channels are least active, the base station can perform an energy scan on all 16 available channels and graphically show the energy levels in a real-time graph. To conduct an energy scan, simply press the *scan* button in a *base station* tab of the server application. Select one of the RF channels showing the least activity during the scan. The desired channel can be selected by pressing the *Set Channel* button.

The screenshot shows a web-based configuration interface for a Base Station. It is titled "Base Station" in the top left. The interface contains several input fields and buttons. On the left, there is a "Get IEEE Address" button next to a text field containing "00124B0001A66485". Below this is a "Set Channel" button next to a dropdown menu showing "24". At the bottom left is a "Reset" button next to another "Reset" dropdown menu. On the right side, there is a "Get Version" button next to a text field containing "IACV0010, IBCV0014". Below that is a "Set Name" button next to a text field containing "Base station 3". At the bottom right is a "Scan" button.

If the RF channel has been changed, the base station will automatically reset itself to apply the new configuration.

Be aware that any ESLs that were already associated with the base station before changing the RF channel will lose their connection with that base station. By default, it will take 30 polls (times the poll interval of 15 seconds—so 450 seconds) before the ESLs will time out and start looking for a useable base station signal.

To avoid having to wait a couple of minutes before the ESLs starts looking for the base station on the new RF-channel it's possible to disassociate all the ESLs from the base station prior to changing the RF channel. This can be done by first pressing the *select all* button, and then the *Remove* button. This will disassociate all ESL's from the base station and the ESLs will start to disappear from the base station's list. Once they're all gone, quickly change the RF channel and the ESLs should start to appear again on the new channel.

Be aware that ESLs don't search for base stations on all 16 RF channels, but only on a configurable range of channels—the default being 11 to 15). So, if the RF channel of the base station is set to a channel outside this range, the ESLs will not find that base station. For this reason it's important to first configure the RF channel range on all ESLs before configuring the base stations. (See section 5.4.5). If an ESL is not associating to any base station, and its RF channel range is unknown, then configure a base station to channel 11. This channel can always be scanned by any ESL, ensuring they can always be found and reconfigured without

having to look for it on all channels.

5.6.2 Changing the Name of a Base Station

To make it easier to distinguish multiple base stations, it's possible to assign a name to base stations. This can be done by editing the text field besides the 'Set Name' button and pressing this button afterwards to store the name inside the base station.

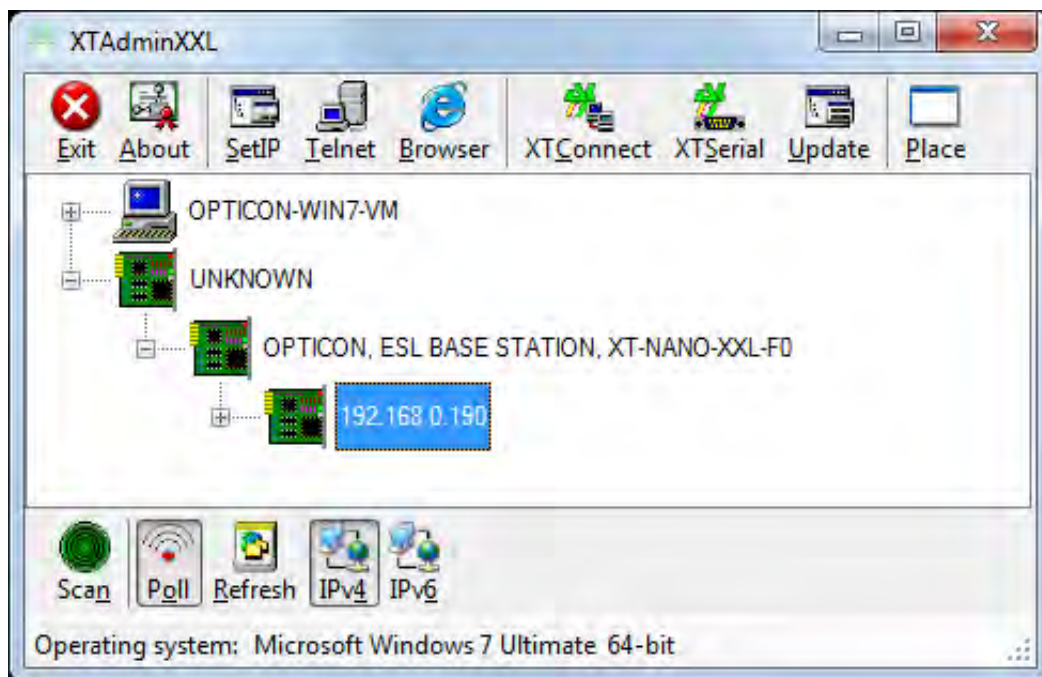
5.6.3 Configuring the Ethernet Settings

To set up the base station for use within an existing network, its DHCP configuration, IP address, and subnet masks need to be configured.

To prevent IP address conflicts when a base station is connected to a network, DHCP is enabled by default. On most installations, a fixed IP address setup is recommended.

If DHCP is used, make sure the DHCP server always assigns the same IP address to the same base station.

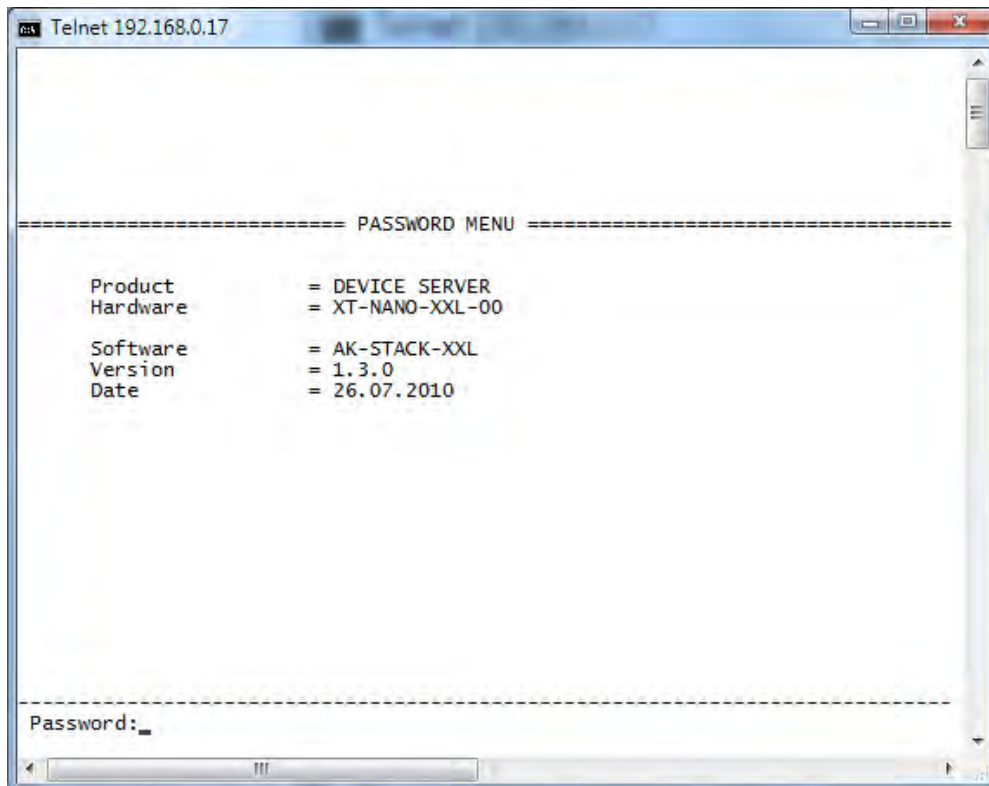
Before IP and DHCP settings can be changed, the base stations need to be found on the network. If no DHCP server is available, the IP address of a base station defaults to *192.168.100.100*, with subnet mask *255.255.0.0*. If a DHCP server is available, then the base station can be found using an external tool called *XTAdminXXL*, which is included in the *Tools* folder of the installation.

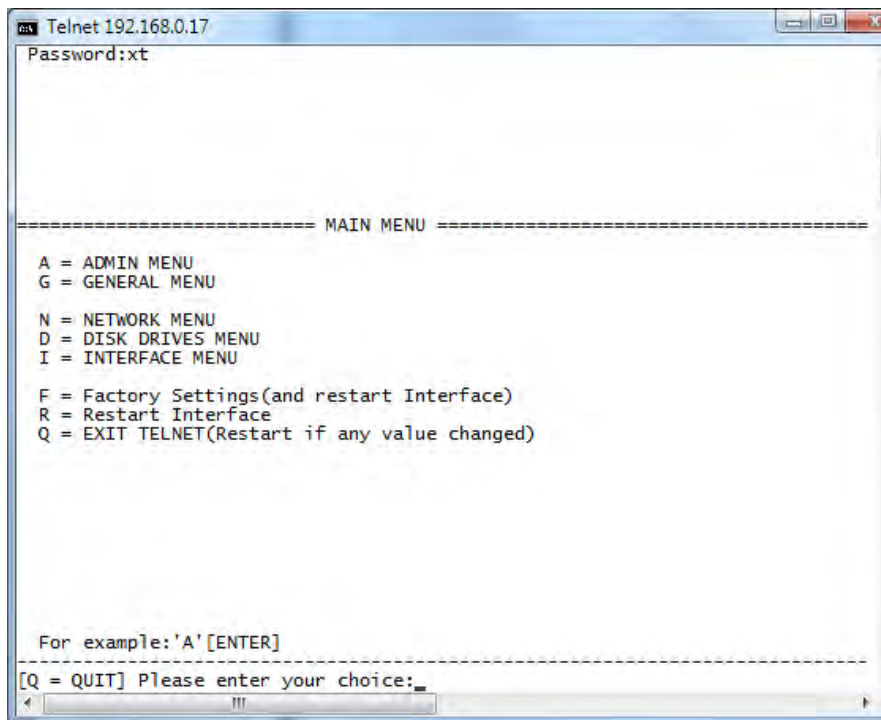


The base stations are clearly identifiable under "OPTICON, ESL BASE STATION, XT-NANO-XXL-F0."

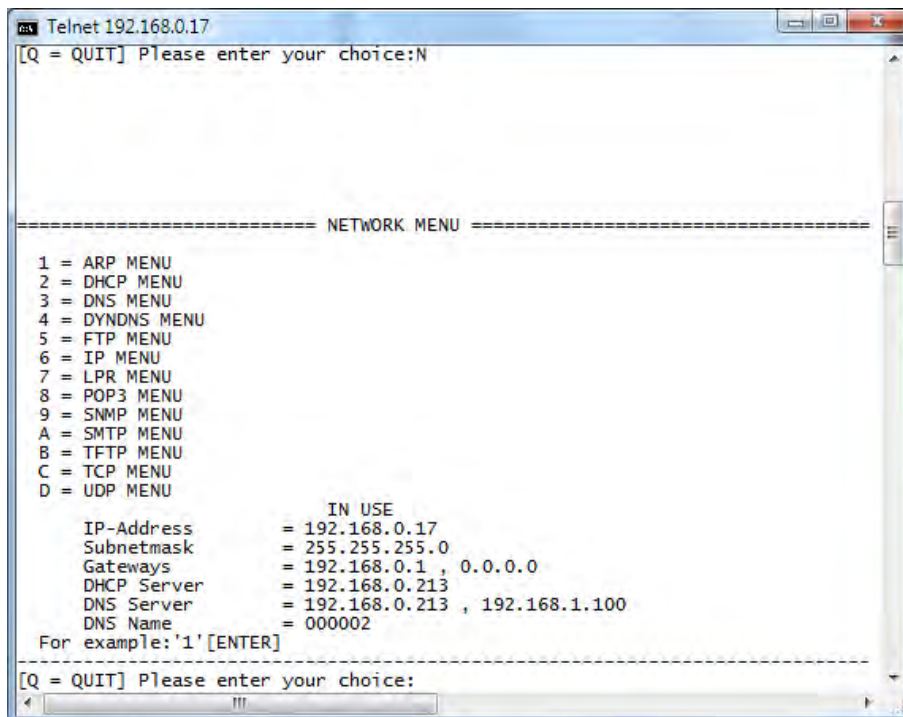
To configure the network settings of the base station, use telnet with the found IP address (i.e. `C:\>telnet 192.168.0.17`) or press 'Telnet' in *XTAdminXXL*. When using *Windows 7*, telnet can be enabled as follows:

1. *Start > Control Panel*
2. *Programs and Features*
3. *Turn Windows features on, or off*
4. Check: *Telnet Client*
5. Click: *OK*





Key in default password *xt*, then press *N* (Network menu).



to
If

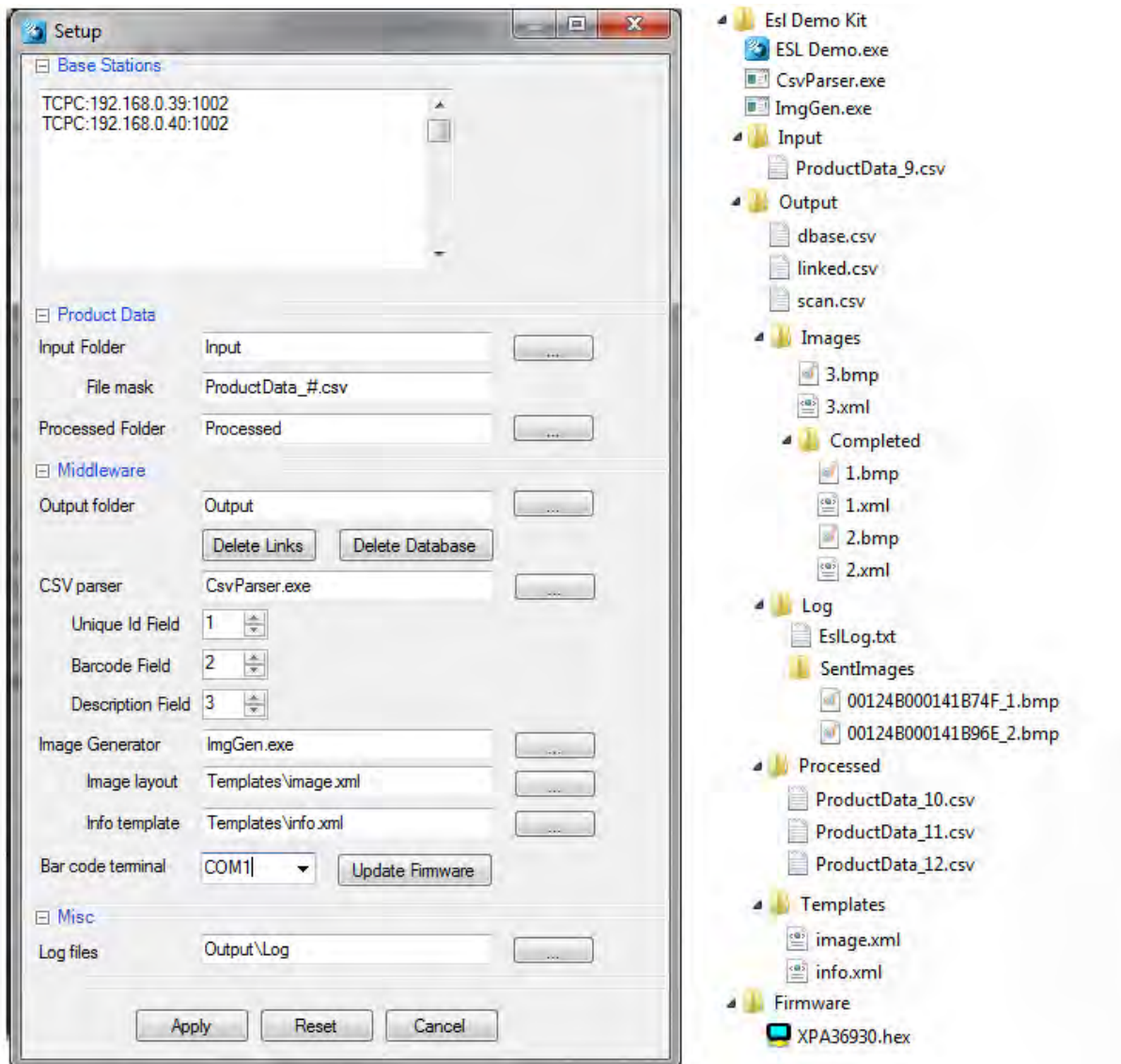
Only DHCP and IP need be configured, all other options need to stay as is. DHCP is not used, please make sure all base stations have a unique IP address and the subnet mask is set correctly.

Trouble shooting:

If for some reason all network settings have been deleted, for instance, when the “Factory settings menu” was used, you can restore the desired settings by uploading a configuration file via FTP server. Contact Opticon for the latest configuration file and upload instructions.

5.7 Setup of the ESL server application

By opening the setup window of the ESL server application, most settings of application can be configured. The image below shows a typical ESL pilot configuration and a matching file system tree.



5.7.1 Base stations

After configuring the network settings of the base stations, add them to this list. The only supported configuration at this moment is a TCP Client (TCP). This means that the ESL Server actively connects to a base station. For every base station, add a line with the following format:

TCP:aaa.bbb.ccc.ddd:port

5.7.2 Input Folder

The *Input Folder* is the location where the back office uploads the new product data files.

File mask: File name mask of the product data file. Currently the only supported mask is `<name>_#.csv` where `#` is any number.

5.7.3 Output

Output is the directory for the middleware applications. It will contain 3 CSV files:

- *dbase.csv* (combined product database)
- *linked.csv* (ESL-products links)
- *scan.csv* (truncated article database that is sent to the terminal)

Also, all automatically generated *BMP* and *XML* files will be placed in the sub-folder: *Images*. (Once processed, the images and *XML* files will be moved to the subdirectory: */Completed*, inside the *Images* folder.)

5.7.4 Delete Links

Delete Links removes all existing links between ESLs and products. Be aware that all links will have to be manually created again using the barcode terminal after doing this. See chapter 1.3 for more information about re-installing an ESL system.

5.7.5 Delete Database

Delete Database removes the complete (combined) database file (*dbase.csv*) from your system. Be aware that a new, full database will have to be placed in the *Input* folder in order to get the ESL system to fully operate again. See section 3.3 for more information about resetting an ESL system.

5.7.6 Processed Folder

The *Processed Folder* is the location to which all processed product data files are copied when all labels have been updated.

5.7.7 CSV parser

CSV Parser is the executable of the middleware application that parses new product data files into a combined database (*dbase.csv*), and generates the truncated article database (*scan.csv*) that is sent to the optional barcode terminal to allow linking of products to ESLs.

By default, the CSV parser expects the following field sequence in the CSV files:

<Modification code>;<Unique ID>;<Barcode>;<Description>;...;...;...etc.

Unique ID field: field number of the unique product ID in a CSV record

Barcode field: field number of the product barcode in a CSV record

Description field: field number of the product description in a CSV record

Note: The optional barcode terminal displays the description when a link is created, so the user can verify that the correct product was linked.

Note: The first field is field number "0", the second is "1", etc.

Note 2: When changing the field sequence of your database, make sure you delete the existing product database files. (See section 1.3 for more information).

5.7.8 Image generator

The *Image Generator* is the executable of the middleware application that parses the product database (*dbase.csv*) and the link database (*linked.csv*) into BMP and XML files for each linked ESL. You can customize the layout of the generated images, and XML files themselves by changing the image layout file (XML-based) and the XML template file.

5.7.9 Image Layout

The *Image Layout* is an XML-based layout file that determines the format of the images that will be displayed on the ESLs. The layout file can only be manually edited using a text/XML editor. This process is described in *Appendix A*.

5.7.10 Info Template

The *Info Template* provides the formatting for the automatically-generated XML files for each linked ESL. In most situations, this template can be left untouched. Only if the positions of the unique ID or the product description aren't located at, respectively, *field 1* and *field 3* in the CSV database, then these field numbers can easily be corrected. (See *Appendix A*).

5.7.11 Optional Barcode terminal

The optional barcode terminal will be polling on the specified serial port for new ESL-product links (*link.csv*) and will update the barcode terminal with the latest product database (*scan.csv*).

5.7.12 Log Files

The *Log Files* will contain all ESL status information (*EslLog.txt*). The *SentImages* subfolder is used by the server application to store the last-sent image to an ESL.

5.7.13 Apply

The *Apply* command saves all settings, and restarts the Application.

5.7.14 Reset

The *Reset* command restores the settings to the last known state.

5.7.13 Cancel

The *Cancel* command allows you to exit without saving any new settings.

6. Middleware Applications

The ESL server application uses middleware applications to process the information from the back office into file formats that the ESL server application uses to update ESL's. The main tasks of the middleware are divided into 2 applications: the *CSV Parser* and the *Image Generator*. These will be described in the following sections.

6.1 CSV Parser

The tasks of the CSV parser are:

- Parse product database files (modifications or complete databases) into a combined CSV database containing all product info.
- Generate a reduced article database (CSV format) for the barcode terminal.

The typical record format of a product modification database is:

```
<Modification code>;<Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.
```

The typical record format of a complete product database is:

```
;<Unique ID>;<Barcode>;<Description>;<Field 4>;<Field 5>;etc.
```

Except for the first field (modification code), the order and quantity of the remaining fields can be varied. See section 5.5.7 for more information on the CSV format.

The record format of the truncated database file (*scan.csv*) that is generated for the optional barcode terminal will have the following format:

```
<Barcode>;<Unique ID>;<Description>
```

If no barcodes are used in your application, or if the *Unique ID* is the barcode, then the *<Barcode>* field will be the same as the *Unique ID*.

The ESL server manager will call up the *CSV parser* with the following parameters, as specified in the *Setup* window of the ESL server application:

```
<CSV parser>.exe -O <Output folder> -i<Id field> -b<Barcode field> -d<Description field> <Database file>.csv
```

So the default call out by the ESL server application would be:

```
CsvParser.exe -O "Output" -i1 -b2 -d3 "Input\ProductData_1.csv"
```

6.2 Image Generator

The task of the Image generator is to generate BMP and XML files for each linked ESL from the combined product database (*dbase.csv*) and the link database (*linked.csv*).

As long as there are no MAC addresses in the link database (*linked.csv*), the middleware won't generate any images for ESLs. Use the optional barcode terminal to create a link database. (See chapter 7).

The ESL server manager will call up the Image Generator with the following parameters, as specified in the *Setup* window of the ESL server application:

```
<Image generator>.exe -O <Output folder> <Image layout>.xml <Info  
template>.xml
```

So, the default call out by the ESL server application would be:

```
ImgGen.exe -O "Output" "Templates\image.xml" "Templates\info.xml"
```

Note: The option '-f' can be added to force an update of all the images of all ESLs in the network. To force such an update on all ESLs, select the Data tab in the server application and press the F8 key.

7. Application for the Optional Barcode Terminal

The barcode terminal can be used to link an ESL (using its unique MAC addresses) to products, objects or locations. How to create these links will be described in the following sections.

7.1 Setting up the Optional Barcode Terminal

If an optional barcode terminal has been included with the ESL kit, it will likely be an Opticon OPH1004, an H13, or the OPL9728. With the barcode terminal, there will also be a USB or RS232 communication cradle. When using the USB cable, it will be necessary to install the Opticon USB driver pack, which can be selected in the *Installer*. The drivers can also be found in the *Tools* folder of this installation.

If the *ESL Linking Application* is not yet loaded on the terminal, or needs to be updated, then the software can be loaded by using the *Update Firmware* option in the *Setup* window of the ESL server manager.

Note: Updating the optional barcode terminal's firmware requires Appload to be installed. Appload can be installed by selecting 'Appload' in the Installer or it can be found in the Tools folder.

To load the software onto the barcode terminal, open the *Setup* window of the ESL server application. Make sure you've selected the correct COM port. Then press the *Update Firmware* button, and select the firmware file for the desired terminal:

- XPA3693x.HEX, for the OPH1004, or the H13
- LBF3693x.S32, for the OPL9728

These files can be found in the *Firmware* folder of this installation. After loading the software, the terminal should display "*ESL LINKING (APPL.)*."

7.2 Loading the Database Files on the Optional Barcode Terminal

Before any links can be created, the reduced product database (*scan.csv*) first has to be loaded on the terminal to allow for the reading of individual product barcodes. The serial port of the PC is used to transfer files between the ESL server application and the optional barcode terminal. Make sure you've enabled and configured the correct serial port in the *Setup* window of the server application (See section 5.7). Also verify that the field numbers of the *Unique ID*, the *barcode* and *description* match your CSV database file (See chapter 5.7). Note that the first field is "0," the second is "1," and so on (i.e., increased by increments of one).

Loading any files onto the terminal and sending back the resulting link database (*linked.csv*), is done by placing the terminal in its cradle. As soon as the combined article database (*scan.csv*), or the link database has been changed, the server application will automatically synchronize the barcode terminal with the PC, and process any modifications.

7.3 Creating Links between ESLs and Products/Locations, Using the Optional Barcode Terminal

Once the firmware has been loaded onto the optional barcode terminal, and is active, the first step in creating a link is to press the *1* key on the terminal's keypad (for *Link ESLs*), and then select the used ESL variant by pressing the *1* key again (for *2" e-paper*), or the *2* key (for *2.7" e-paper*).

The next step is to scan the barcode on the back of an ESL. At this time, there should be an audible indicator ("*beep*") from the terminal, and visual confirmation with the ESL's full MAC address in the terminal's display.

If the physical barcode on the back of an e-paper ESL is not accessible, it is also possible to view this same barcode on the e-paper ESL's display. To do so, select all ESLs in the server application that have not yet been linked, then select the *image* checkbox and press the *Reset* button. Each of the selected ESLs will then display its default barcode image containing its unique MAC address.

After scanning the MAC address, you can either manually enter the *Unique ID* or scan the barcode of the product that you want to link to this ESL.

After scanning, or entering the product, the terminal's displayed message should be "*Linking successful!*" If that particular product cannot be found in the database, the message displayed will "*Product not found.*"

If you accidentally linked the wrong product to an ESL, then you can correct this by scanning the ESL's MAC address again and linking it to the correct product.

7.4 Deleting Existing Links

To delete existing links from the link database, press the “2” key (for *Unlink ESLs*) on the optional barcode terminal’s keypad. Deleting an existing link can be done by either entering the product ID, or by scanning the product barcode, or scanning the MAC address of the ESL.

7.5 Verifying existing links

It is possible to check whether a product has been correctly linked by pressing the “3” key (for *Product Info*) on the optional barcode terminal’s keypad. To show the product information and the linked ESL, either enter the product ID, or scan the product barcode, or scan the MAC address of the ESL.

7.6 Sending the Modified Link Database to the PC

After all links have been created using the optional barcode terminal, the link-related information needs to be sent back to the PC, for processing by the server application. This can be accomplished by placing the terminal back into its cradle. The terminal should now automatically upload the link database (*linked.csv*) to the PC.

Subsequently, the ESL server application will call up the middleware application to parse the combined database and link database into ESL image files (bitmaps) and configuration (XML) files, and update the ESLs if necessary.

7.7 Settings menu

The settings menu of the terminal can be accessed by pressing the 4 key (for *Settings*) on the optional barcode terminal’s keypad. This menu contains two options:

1. *Delete data*: Deletes all files from the terminal, and therefore all links that have not yet been sent back to the PC
2. *Barcodes*: This menu can enable or disable different barcode symbologies, so almost all barcodes can be scanned

7.8 Version

Version identifies which revision of the terminal application is installed. This information can be useful for support purposes.

8. Version history

V0.1	First final release	February 21, 2012

9. Appendices

Appendix A: Editing the ESL Template Files

The ESL template files are XML-based and can be manually edited to design your own label layout.

The ESL server application uses two templates.

- An image template that specifies the actual image layout of the images that will be generated
- An information template that is used to generate XML-files that provide the ESL server application with all the necessary information about the linked ESL and product (*Unique ID*, *MAC address*, and *description*)

A.1 Editing the Information Template

As mentioned above, the information template is used to provide the ESL server application with all the required information for each ESL: the *Unique ID*; the *MAC address*; and a description of the linked product.

Note: The “description” will be shown in the data tab of the ESL server application.

The default location of the information template is `./Templates/Info.xml`.

This template consists of the following:

```
<?xml version="1.0" encoding="utf-8"?>
<EslImageInfo>
  <Label></Label>
  <ImageFile>%1%.bmp</ImageFile>
  <X>0</X>
  <Y>0</Y>
  <Width></Width>
  <Height></Height>
  <HOffset>0</HOffset>
  <VOffset>0</VOffset>
  <Ix>0</Ix>
  <Variant></Variant>
  <Note>%3%</Note>
</EslImageInfo>
```

Only two fields of this template may have to be changed, depending on the field sequence of your CSV database. The fields which may need to be corrected are:

- `<ImageFile>`: Needs to contain the field number of the *Unique ID*
- `<Note>`: Needs to contain the field number of the product description

The field number is specified between the “%” symbols. Note that the first field in the sequence is assigned field number “0.”

For example, if the CSV file has the following field sequence:

```
<Modification code>;<Barcode>;<Unique ID>;<Price>;<Description>;
```

The lines should be changed to:

```
<ImageFile>%2%.bmp</ImageFile> and <Note>%4%</Note>
```

A.2 Editing the Image Layout Template

The image layout template is also XML-based and can be manually edited to design your own label layout. The default location of the image template is *./Templates/Image.xml*. The image template currently supports 5 types of objects for designing the ESL layout:

- Text (fixed and dynamic)
- Lines
- Rectangles (filled)
- Images (monochrome; fixed and dynamic)
- Barcodes

These objects should be added to the template file using the following formatting:

```
<?xml version="1.0" encoding="utf-8"?>
<EslLayoutInfo>
  <EslTemplate>
    <Variant>H</Variant>
    <Width>200</Width>
    <Height>96</Height>
    <Object>
      <Text>
        ...
      </Text>
    </Object>
    <Object>
      <Rectangle>
        ...
      </Rectangle>
    </Object>
    <Object>
      <Image>
        ...
      </Image>
    </Object>
    <Object>
      <Line>
        ...
      </Line>
    </Object>
    <Object>
      <Barcode>
        ...
      </Barcode>
    </Object>
```

```
</EslTemplate>
</EslLayoutInfo>
```

The desired image will be generated by parsing the template from top to bottom, so if one object needs to be drawn on top of another, then this can be done by changing the sequence of the objects in the image template.

The “*Variant*” field specifies the hardware variant of the ESL for each template. Multiple templates can be added if more than one hardware variant is used.

The dynamic content of texts, barcodes and images can be inserted into your template from the CSV database. To add a certain field from a CSV record to your image, add the number of the target field into the template between the two “%” characters in the content field of the object.

For example, if the CSV file has the following field sequence

```
<Modification code>;<Barcode>;<Unique
ID>;<Price>;<Description>;<Weight>;<Unit>;
```

(and so on), then the *Price* field would be added by using “%3%”, since it is field number 3 (starting from *Modification code*, which is field number 0).

Combining multiple fields as dynamic content is also allowed.

An example of adding dynamic content (e.g., adding weight plus a standard unit) would be:

```
<Content>Weight: %5% %6%</Content>
```

Special characters can be added using the standard XML notation. For instance a “&” sign can be added using: `&` (since its Unicode is U+0026)

Any type of object can be added to the template conditionally if needed, meaning that it is only shown in the resulting image if a certain field in a CSV record contains a value or equals a certain value.

This is can be done by adding one of the following lines to any type of object.

```
<!-- Object if only displayed if field 'x' contains a value -->
<Condition>%x%</Condition>
```

```
<!-- Object if only displayed if field 'x' equals 'y' -->
<Condition>%x%=y</Condition>
```

The following sections will describe the 5 types of object in more detail.

A.3 Adding or Editing Text

Text can added to the template using the following format:

```
<Object>
  <Text>
    <Content>%3%</Content>
    <Color>1</Color>
    <X>0</X>
    <Y>3</Y>
    <Width>200</Width>
    <Height>28</Height>
    <Font>
      <Type>Arial</Type>
      <Size>11</Size>
      <Italic>1</Italic>
      <Bold>1</Bold>
    </Font>
    <Lines>2</Lines>
    <HAlignment>CENTER</HAlignment>
    <VAlignment>CENTER</VAlignment>
  </Text>
</Object>
```

- <Condition> (optional) Displaying conditions
- <Content> The Dynamic/fixed text to be rendered
- <Color> Text color (0=Black; 1=White)
- <X> <Y> <Width> <Height> Specify the rectangle within the text is rendered
- Specifies the type, style and size of the used font
- <Lines> Number of lines the text may be wrapped if needed
- <HAlignment> Horizontal alignment (LEFT, CENTER or RIGHT)
- <VAlignment> Vertical alignment (TOP, CENTER, BOTTOM)

A.4 Adding Rectangles

A (filled) rectangle can be added to the template using the following format:

```
<Object>
  <Rectangle>
    <X>0</X>
    <Y>0</Y>
    <Width>200</Width>
    <Height>32</Height>
    <Color>0</Color>
  </Rectangle>
</Object>
```

- <Condition> (optional) Displaying conditions
- <Color> Color (0=Black; 1=White)
- <X> <Y> <Width> <Height> Specify the position and size of the rectangle

A non-filled rectangle can be added by simply drawing two rectangles on top of each other in opposite colors.

A.5 Adding Lines

A line can be added to the template using the following format:

```
<Object>
  <Line>
    <X1>0</X1>
    <Y1>77</Y1>
    <X2>200</X2>
    <Y2>77</Y2>
    <Size>1</Size>
    <Color>0</Color>
  </Line>
</Object>
```

- <Condition> (optional) Displaying conditions
- <Color> Color (0=Black; 1=White)
- <X1> <Y1> <X2> <Y2> Specify start/end coordinates
- <Size> Thickness of the line

A.5 Adding Images

An image (fixed or dynamic) can be added to the template using the following format:

```
<Object>
  <Image>
    <File>Templates\demo.bmp</File>
    <X>173</X>
    <Y>33</Y>
  </Image>
</Object>
```

- <Condition> (optional) Displaying conditions
- <File> Image file path (absolute or relative to working directory)
- <X> <Y> Coordinates of the upper-left corner of the image

A.6 Adding Barcodes

Almost any type of barcode can be added to the template using the following format:

```
<Object>
  <Barcode>
    <Content>%2%</Content>
    <Type>1</Type>
    <Color>0</Color>
    <X>50</X>
    <Y>80</Y>
    <Width>100</Width>
    <Height>20</Height>
    <HAlignment>CENTER</HAlignment>
    <VAlignment>BOTTOM</VAlignment>
  </Barcode>
</Object>
```

- <Condition> (optional) Displaying conditions
- <Content> Content of the barcode
- <Color> Foreground Color (0=Black; 1=White)
- <Type> Specifies the bar code type (See list below)
- <X> <Y> <Width> <Height> Specifies which rectangle to render a barcode
- <HAlignment> Horizontal alignment (LEFT, CENTER or RIGHT)
- <VAlignment> Vertical alignment (TOP, BOTTOM)

A.7 Barcode Types

The barcode type can be one of the following values:

1. UPC-A
2. UPC-E
3. UPC 2 Addon/supplemental chars
4. UPC 5 Addon/supplemental chars
5. EAN-13
6. EAN-8
7. Interleaved 2of5
8. Standard 2of5
9. Industrial 2of5
10. Code-39
11. Code-39 Full ASCII
12. Codabar
13. PostNet
14. BOOKLAND
15. ISBN
16. JAN13
17. MSI (Mod10)
18. MSI (Mod10/Mod10)
19. MSI (Mod11)
20. MSI (Mod11/Mod10)
21. Modified Plessey
22. Code-11
23. USD8
24. UCC-12
25. UCC-13
26. LOGMARS6
27. Code-128
28. Code-128 (Code-set A)
29. Code-128 (Code-set B)
30. Code-128 (Code-set C)
31. ITF14 (Interleaved 2of5 14 digits)
32. Code-93
33. Telepen

Please note that the content of a barcode usually must match various criteria (i.e. fixed length and check digits) in order for it to render properly. If a barcode is not (correctly) rendered, then please check the log-file of the parsed CSV file in the *Processed* folder for more information about the cause of the problem.

A.8 Format Trouble Shooting

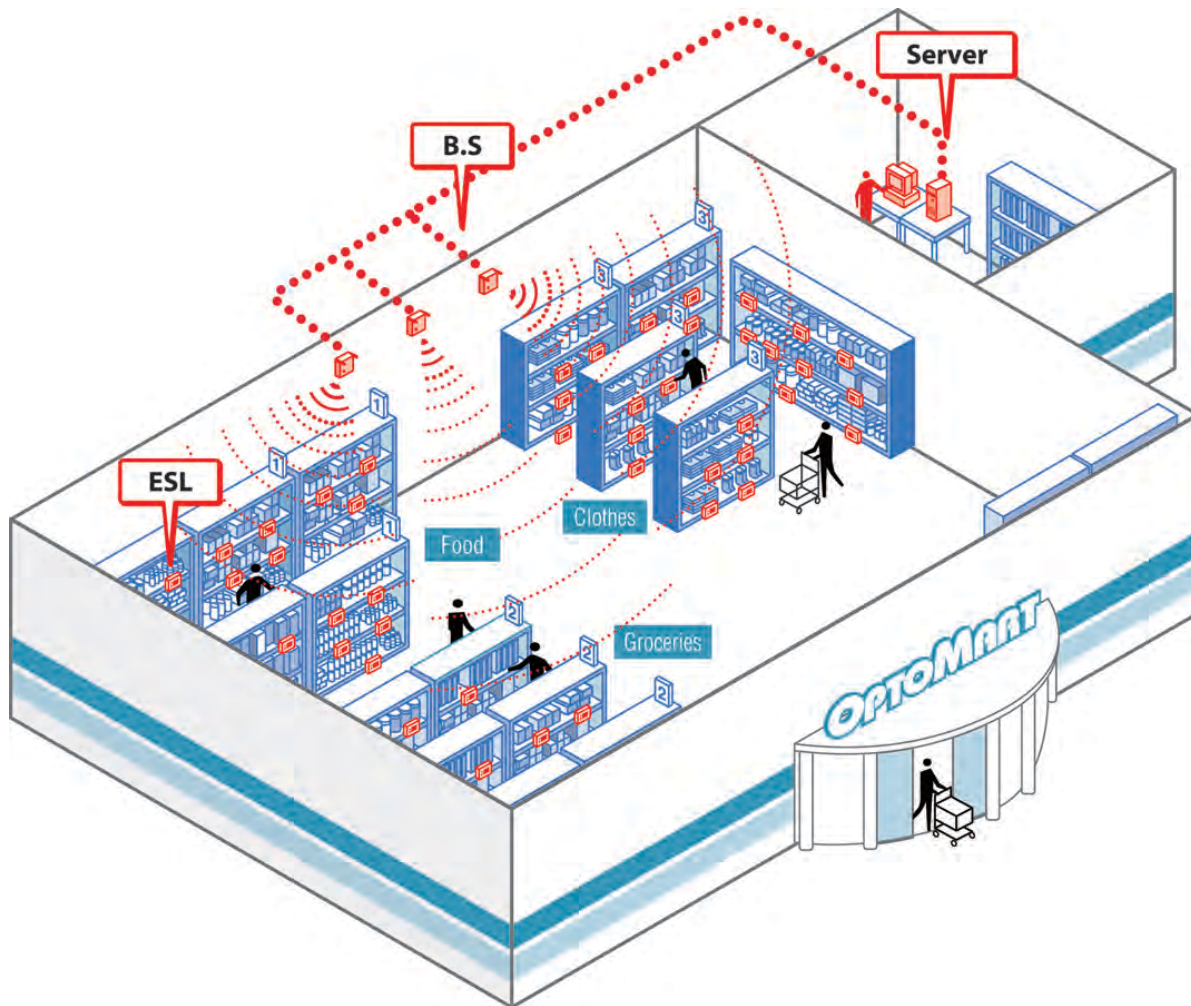
1. Formatting Errors:
If an XML file contains a format error, then no images will be generated. Information about format errors can be found in the log file of the parsed CSV file in the *Processed* folder. Also, opening the XML files in an Internet Browser can often quickly reveal the problem.
2. Barcode rendering problems:
The content of a barcode usually must match various criteria (i.e. fixed length and check digits) in order it to render properly. Please check the log file of the parsed CSV file in the *Processed* folder for more information about the cause of rendering issues.
3. Incorrectly configured field numbers:
Make sure that the field numbers (*Unique ID*, *barcode*, and *description*) in the *Setup* window of the ESL server application match the field sequence of your CSV export. (Remember that field numbering starts at 0, from left to right).
4. Make sure the *Unique ID* field is correctly set in the `<ImageFile>` field of the information template.
5. Make sure the field numbers in the image layout template are correct.

Appendix B: Example Barcodes

The quickest way to setup an ESL demonstration is to simply use the included sample database and example templates. After installation of the software and hardware, the only configuration step necessary are configuring the IP address of the base station and the serial port of the barcode terminal in the Setup windows of the ESL server application. After that, the demo database file should be automatically sent to the barcode terminal and then you can link your ESLs using the barcode terminal and the product barcodes in the images below. (See chapter 7).

Grocery Item 1 From: \$1.25 \$0.99 ☆ 100 oz  .0099/oz	Grocery Item 2 \$1.99 ☆ 200 oz  .0199/oz	Grocery Item 3 \$2.99 ☆ 300 oz  .0299/oz	Grocery Item 4 SALE \$3.99 ☆ 400 oz  .0399/oz
Grocery Item 5 \$4.99 ☆ 500 oz  .0499/oz	Grocery Item 6 LOW PRICE \$5.99 ☆ 600 oz  .0599/oz	Grocery Item 7 \$6.99 ☆ 700 oz  .0699/oz	Grocery Item 8 SALE \$7.99 ☆ 800 oz  .0799/oz
Grocery Item 9 \$8.99 ☆ 900 oz  .0899/oz	Grocery Item 10 \$9.99 ☆ 1000 oz  .0999/oz	Grocery Item 11 From: \$15.99 \$10.99 ☆ 1100 lb  .1099/lb	Grocery Item 12 \$11.99 ☆ 1200 lb  .1199/lb
Grocery Item 13 \$12.99 ☆ 1300 lb  .1299/lb	Grocery Item 14 SALE \$13.99 ☆ 1400 lb  .1399/lb	Grocery Item 15 \$14.99 ☆ 1500 lb  .1499/lb	Grocery Item 16 LOW PRICE \$15.99 ☆ 1600 lb  .1599/lb
Grocery Item 17 \$16.99 ☆ 1700 lb  .1699/lb	Grocery Item 18 SALE \$17.99 ☆ 1800 lb  .1799/lb	Grocery Item 19 \$18.99 ☆ 1900 lb  .1899/lb	Grocery Item 20 \$19.99 ☆ 2000 lb  .1999/lb

Appendix C: Example ESL Layout Illustration



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- The Netherlands: Hoofddorp
- France: Issy Les Moulineaux
- Germany: Dietzenbach
- Italy: Villanova di Castenaso (BO)
- Sweden: Järfälla
- United Kingdom: Luton, Bedfordshire
- U.S.A.: Renton, WA
- Brazil: São Paulo

- Japan: Warabi City
- Taiwan: Taipei
- P.R.China: Shanghai
- Australia: West Ryde

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